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Site selection in Northern Ghana

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The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government’s Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.

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**Introduction**

The Africa RISING program of the USAID-Feed the Future initiative proposes to initiate and test interventions to enable Sustainable Intensification (SI) of agriculture in three major regions of Africa by working in three “mega-sites” which exemplify the main climatic and human characteristics of these regions.

Some districts in Northern Ghana and Southern Mali are the target areas in the West Africa mega-site. This report provides the site selection analysis for the districts and communities in Northern Ghana, while the site selection in Southern Mali is managed by the ICRISAT-Mali office.

Nadowli, Wa, and Wa west from upper west region; Bawku West, Kassena Nankana, Bongo, and Talensi Nabdam from upper east region; Savelugu Nanton, Tolon-Kumbungu, Yendi, and Tamale from the northern region have been selected as focused areas in the country. The districts are highlighted in Figure 1. Collaborators on the ground chose communities within each district, also illustrated in the map. The full list of the 52 proposed sites/communities is shown in Table 1 with district names, community names and their associated location.

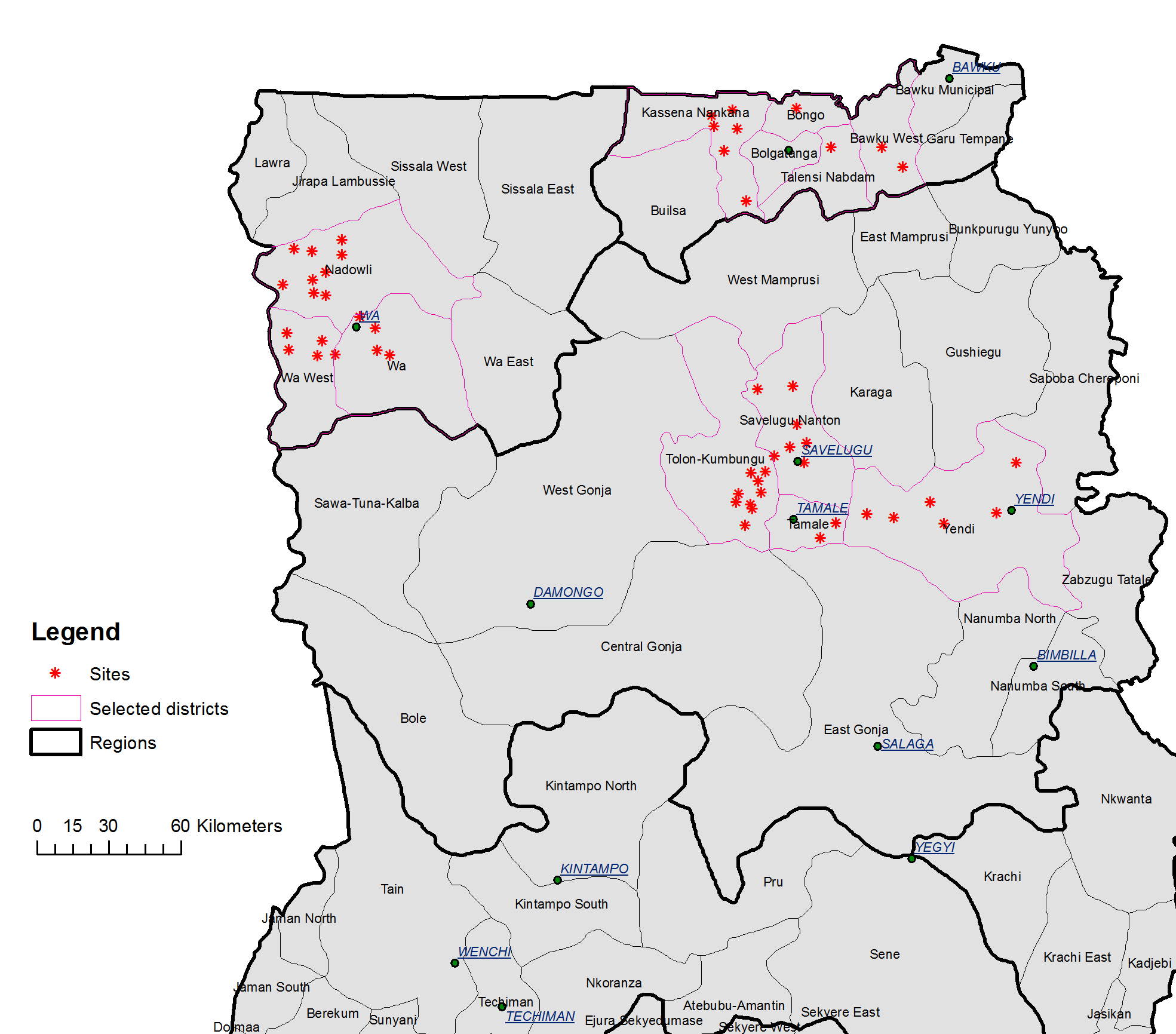
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Figure 1. Focused districts and proposed sites in Northern Ghana

|  |  |  |  |
| --- | --- | --- | --- |
| **districts** | **community** | **longitude** | **Latitude** |
| tolong | nyorin | -1.03546 | 9.49404 |
| tolong | balinkpen | -0.99184 | 9.45408 |
| tolong | cheyohi | -0.98544 | 9.43944 |
| tolong | gizaa | -1.04614 | 9.46353 |
| tolong | tingoli | -1.01167 | 9.37538 |
| kassena-nankana | tampola | -1.08969 | 10.77788 |
| kassena-nankana | bonia | -1.12764 | 10.87064 |
| kassena-nankana | gia | -1.13678 | 10.91069 |
| mion | zuro | -0.55516 | 9.41941 |
| mion | zakpalsi | -0.3194 | 9.46281 |
| mion | sanzei | -0.26779 | 9.38305 |
| mion | tuya | -0.45429 | 9.40533 |
| savelugu | zosali | -0.83315 | 9.8968 |
| savelugu | nakpanzoo | -0.81673 | 9.75487 |
| savelugu | kpallung | -0.78154 | 9.6845 |
| savelugu | tibali | -0.84488 | 9.66808 |
| savelugu | botingli | -0.78975 | 9.6106 |
| wa west | janke | -2.59458 | 10.06642 |
| wa west | tomare | -2.72591 | 10.09518 |
| wa west | guabe | -2.71903 | 10.03452 |
| wa west | oir | -2.61272 | 10.01138 |
| wa west | nakori | -2.54581 | 10.01576 |
| nadowli | kulankagla | -2.7432 | 10.27752 |
| nadowli | natordari | -2.62636 | 10.24522 |
| nadowli | papu | -2.58076 | 10.23668 |
| nadowli | goli | -2.63016 | 10.29462 |
| nadowli | bili | -2.58171 | 10.32502 |
| bawku west | azoawera | -0.49997 | 10.79173 |
| bongo | sabulunga | -0.82034 | 10.93778 |
| talensi-nabdam | pelungu | -0.68861 | 10.79233 |
| bawku west | buliga | -0.42078 | 10.71754 |
| kassena nankana | naaga | -1.00759 | 10.59122 |
| kassena nankana | doba | -1.04008 | 10.86181 |
| kassena nankana | nyangua | -1.05948 | 10.93018 |
| kumbungu | kpirim | -0.98988 | 9.57207 |
| kumbungu | logushegu | -0.96302 | 9.5421 |
| kumbungu | gbanzogu | -0.95095 | 9.49927 |
| tamale mun | yimahinayili | -0.672 | 9.38491 |
| tamale mun | jerigo | -0.72985 | 9.32981 |
| yendi | kulukpene | -0.0698 | 9.42348 |
| yendi | nasiuk | 0.00457 | 9.6119 |
| savelugu | dinga | -0.96566 | 9.88546 |
| savelugu | tarikpaa | -0.90299 | 9.63615 |
| savelugu | zugu | -0.93467 | 9.57761 |
| nadowli | paria | -2.69981 | 10.41093 |
| nadowli | tachiripie | -2.63232 | 10.40198 |
| nadowli | bakpa | -2.52144 | 10.44606 |
| nadowli | wola | -2.52075 | 10.38958 |
| wa municipal | sako | -2.45463 | 10.1568 |
| wa municipal | kodali | -2.3954 | 10.11479 |
| wa municipal | dodayiri | -2.38921 | 10.03146 |
| wa municipal | sakaripea | -2.34306 | 10.01287 |

Table 1. Proposed sites in Northern Ghana

**Review of biophysical and socio-economic characteristics in the proposed northern districts**

In order to stratify and characterize the focused districts, a review of available spatial biophysical and socio-economic data layers is presented. The main purposes are to: 1. Understand the spatial pattern and homogeneity of each of the candidate data layers; 2. Choose the appropriate dataset for the stratification analysis.

Among the candidate layers on population density, Agro-Ecological Zones, precipitation, elevation, slope, farming system, market access, Length of Growth Period (LGP), and land cover datasets (listed in Table 2), only some of them were deemed to be appropriate to characterize and stratify districts in Northern Ghana, given their spatial variability.



Table 2. Characteristics of the candidate data layers

The relevant variables are first mapped in order to visualize their spatial distribution, and then they are aggregated by classes.

1. **Population density**

Population density in Northern Ghana is generally low. Most of the area shows population density lower than 100 persons per squared kilometer, and it is classified into 3 categories with the following cut-offs: less than 15, 16 -50, and greater than 50.

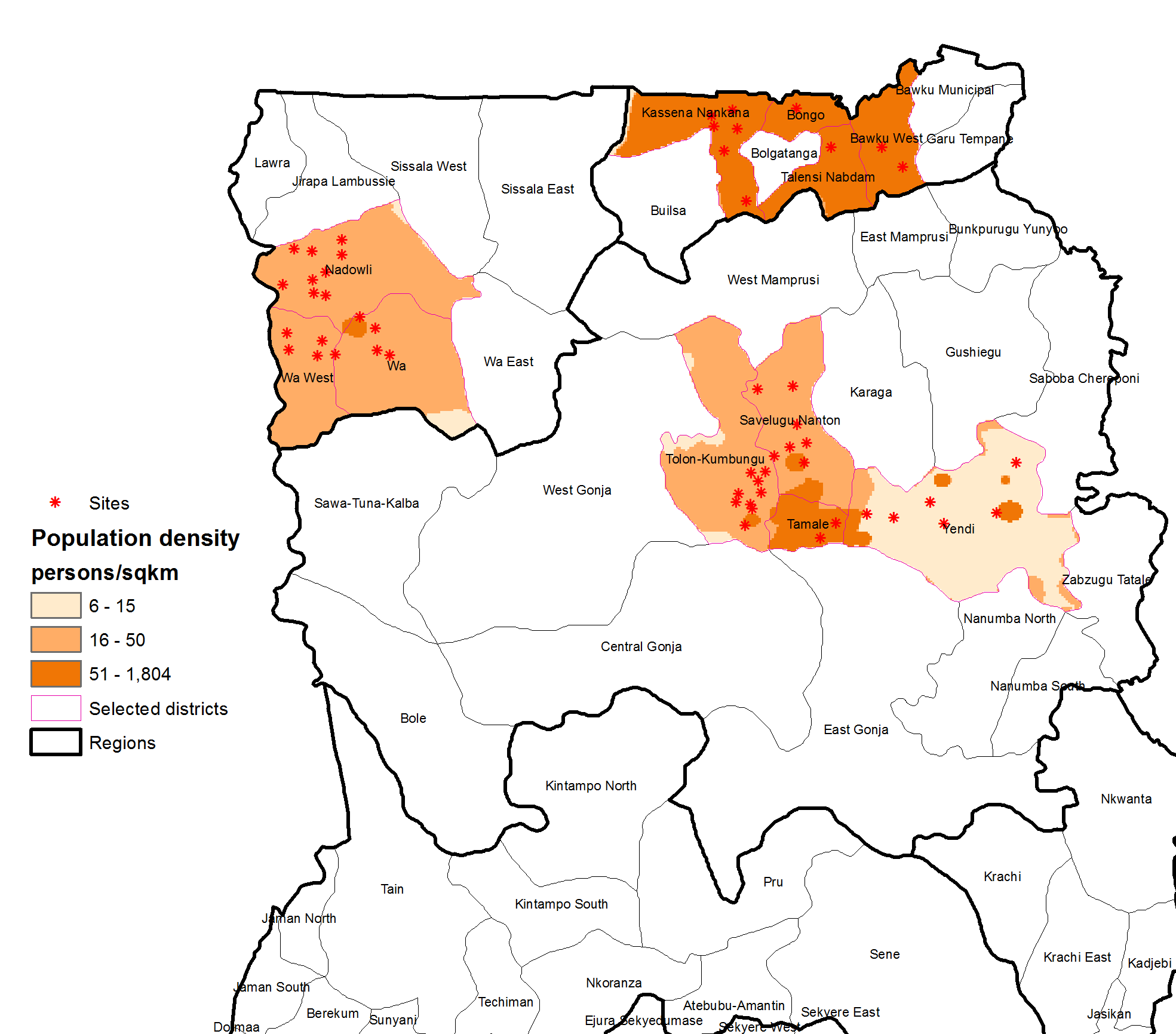
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Figure 2. Population density

1. **Elevation**

There are many datasets available on elevation for Ghana: the USGS Hydro1k data layer has been chosen because most of the other data used in Africa RISING site selection analysis is at 1km resolution. In order to avoid arbitrary selection of cut-off values, the quintile of elevation distribution at 1km pixel level has been used. In Northern Ghana, the spatial heterogeneity in the measurement of altitude is relatively low, as the elevation ranges from 87 meters to 393 meters.

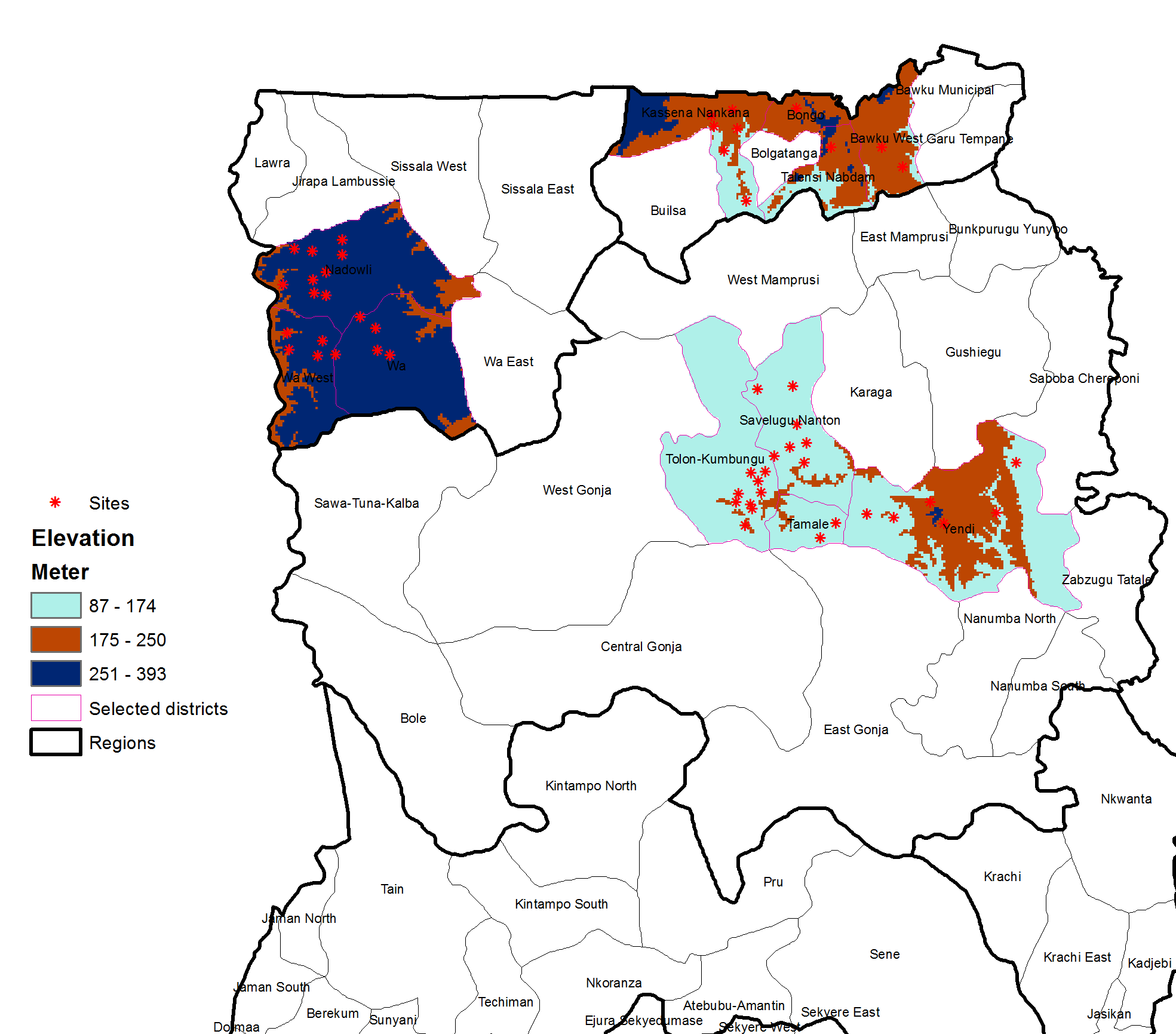


Figure 3. Elevation

1. **Precipitation**

Even though there are several publicly available precipitation data layers, most of them are more suitable to global studies than to country or sub-national analysis, being at a very coarse resolution. There are two methods to derive precipitation data point at the pixel level. One is from weather station records with spatial interpolation. The second method is from satellite observation.

The data from WorldClim has the highest spatial resolution, at 1km (**Error! Reference source not found.**4). Nevertheless, these data need to be used with caution, as their reliability has been questioned from various parts.

Other possible climatic data sources are CRU, NASA POWER, and GPCC, being all at half degree resolution. Their main drawback is the very coarse resolution, which makes them inadequate for the analysis on the focused districts.

To overcome the low resolution problem, the suggested option is to look at the length of growth period, analyzed in the next paragraph.

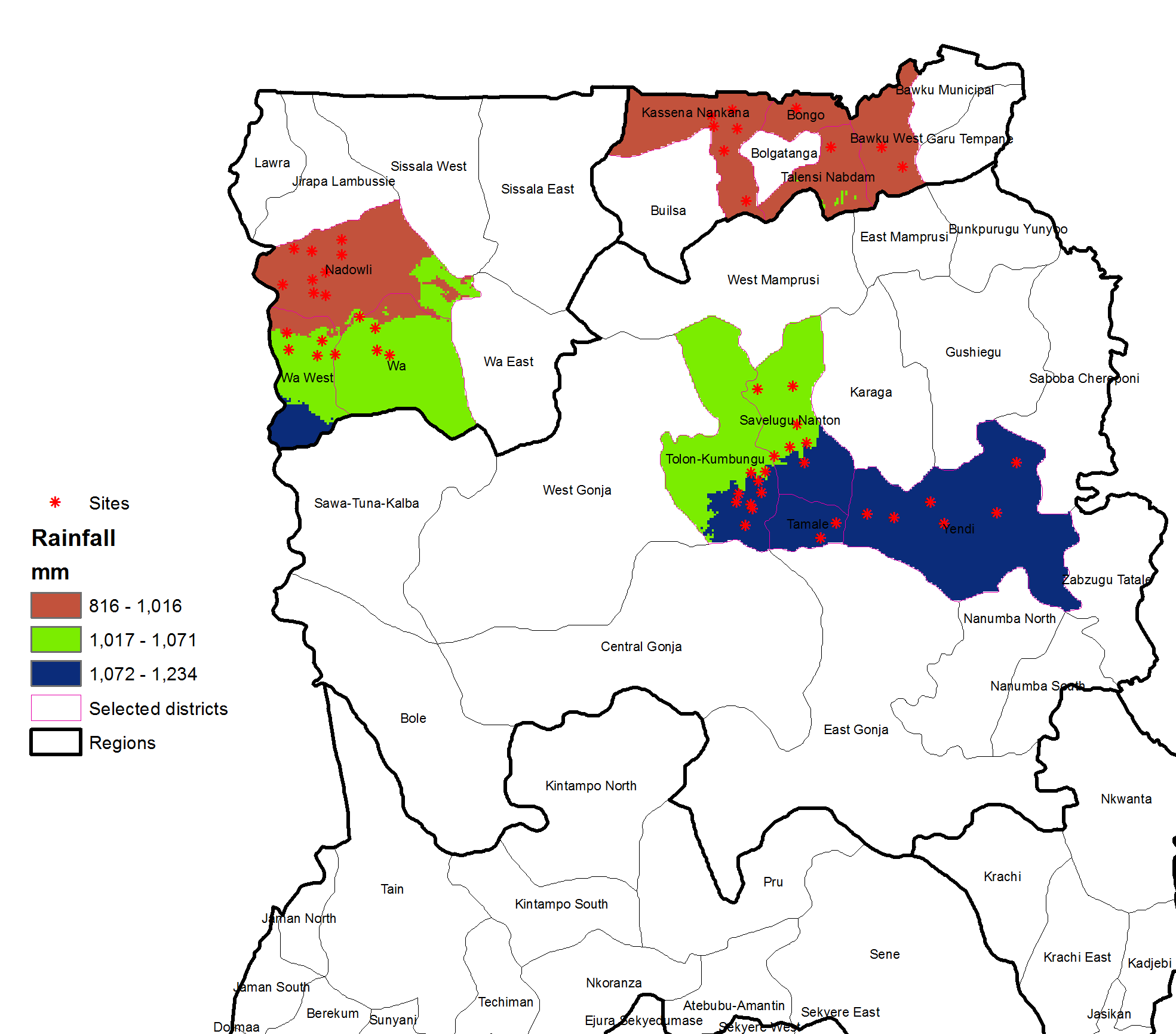


Figure 4. Long-term average precipitation (source: WorldClim)

1. **Length of growth period**

The length of growth period, a good proxy of agriculture potential, measures how many continuous suitable days are available for the crop to grow based on soil water capacity holding, soil moisture, temperature, and elevation. Two sources of length of growth period datasets are proposed. One is by IIASA at global scale at 10km2 resolution. The other one is by ICRISAT and is at a finer resolution level (5km2). Both maps are displayed in Figure 5 and 6. For this analysis, the LGP by ICRISAT is used, as it is at a higher resolution and deemed to be more reliable. Northern Ghana shows a clear gradient in terms of agriculture potential from North to South looking at ICRISAT data, which makes its use particularly appropriate in the stratification analysis.

The continuous distribution of LGP in Figure 6 was classified in four groups, with a flexible first threshold of 162 days (taken as the first quartile), and a predetermined thresholds of 180 and 190 days, shown in Figure 7 below. The four classes are then used for stratification purposes. According to this classification, the focused districts in the Upper West region are classified into low agriculture potential, while the Yenti district has the highest potential.

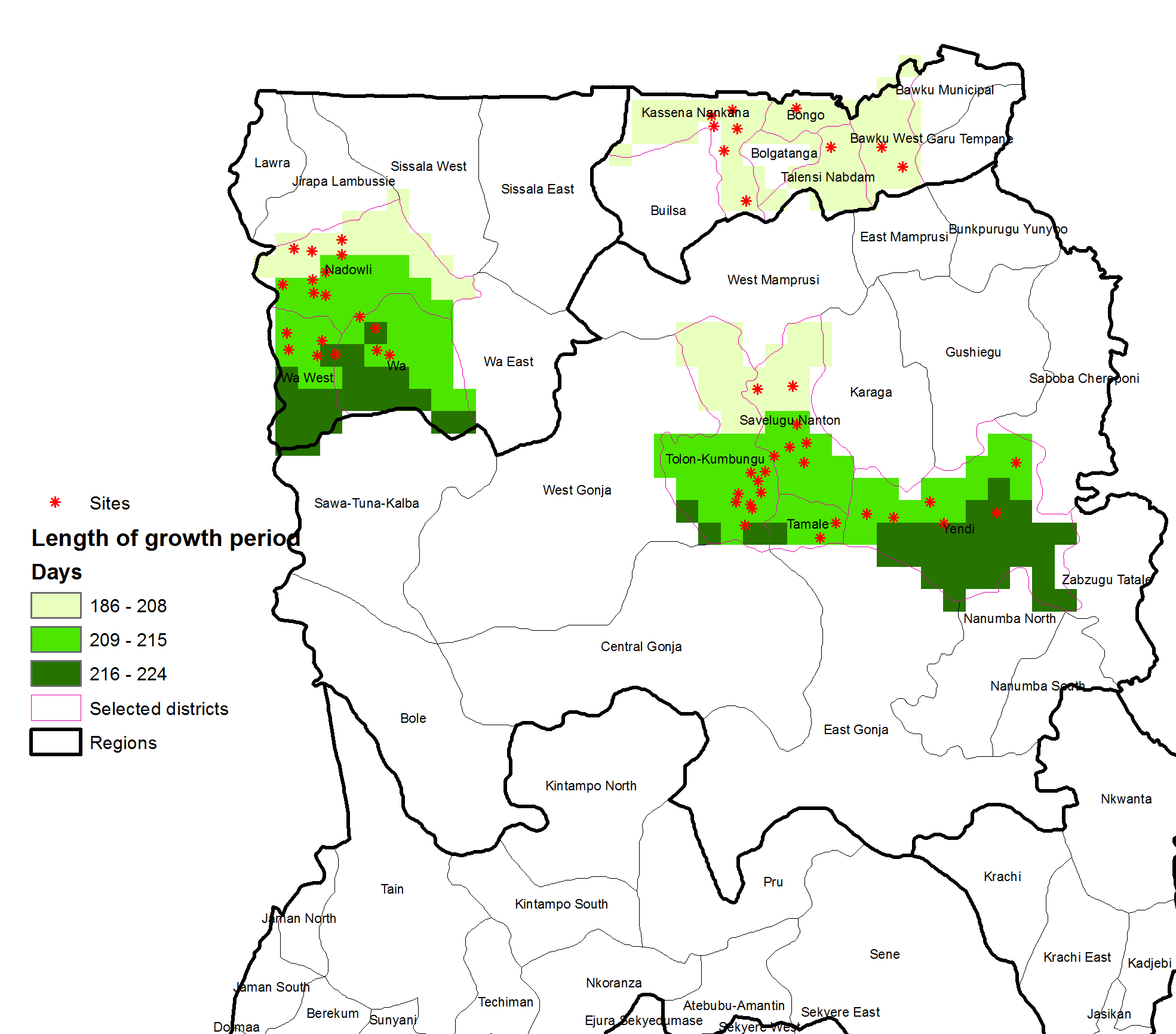


Figure 5. Length of growth period (source: IIASA)

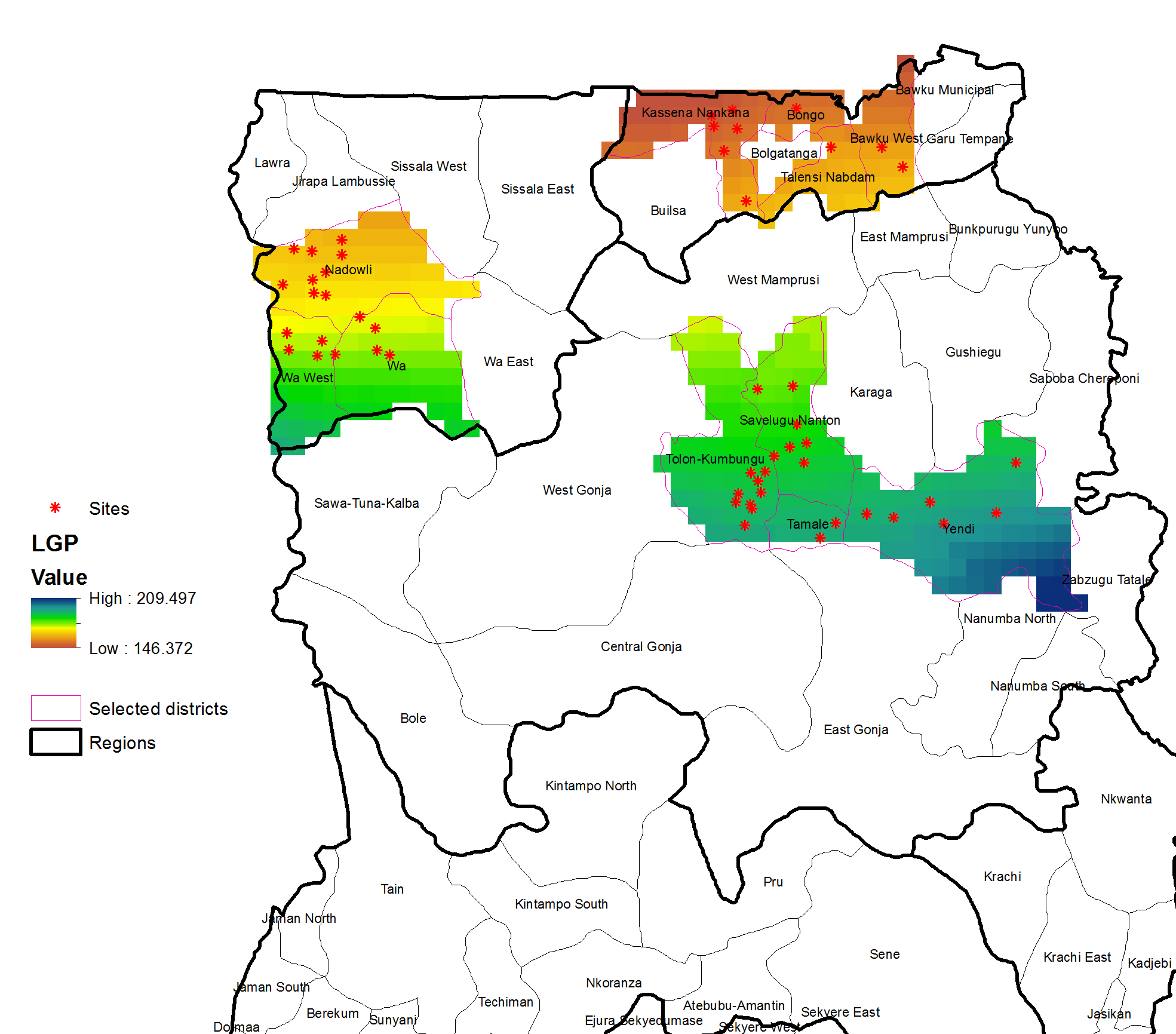
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Figure 6. Length of growth period (source: ICRISAT)

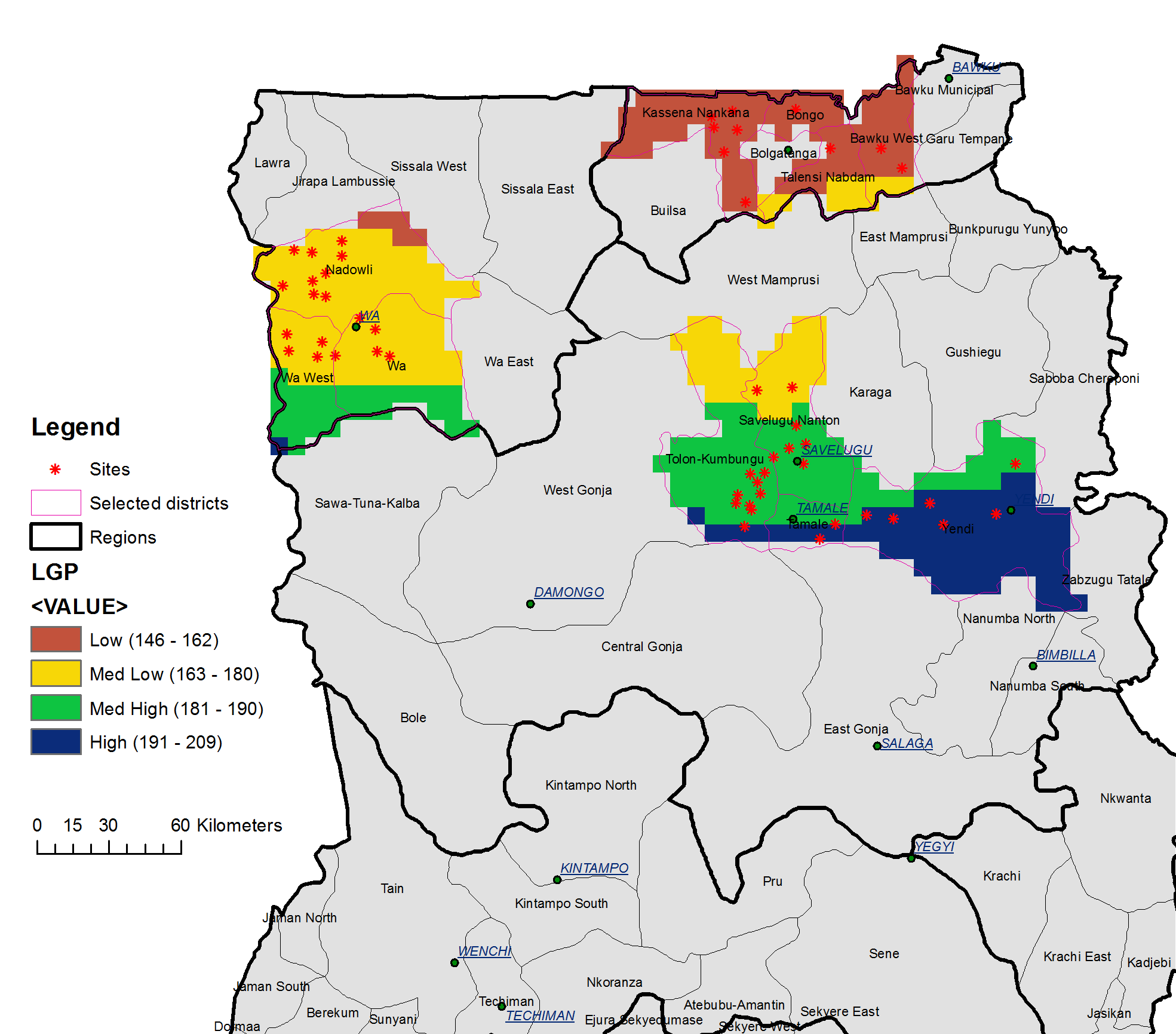


Figure 7. Classified LGP from ICRISAT (four classes: low, med-low, med-high, high)

1. **Market Access**

Market access is largely used as an indicator of accessibility. The tercile classification (high, medium, and low) based on travel time in minutes to the nearest city with at least 50 thousand people is applied in this analysis. The district of Tamale has the highest accessibility, while Wa has the lowest.

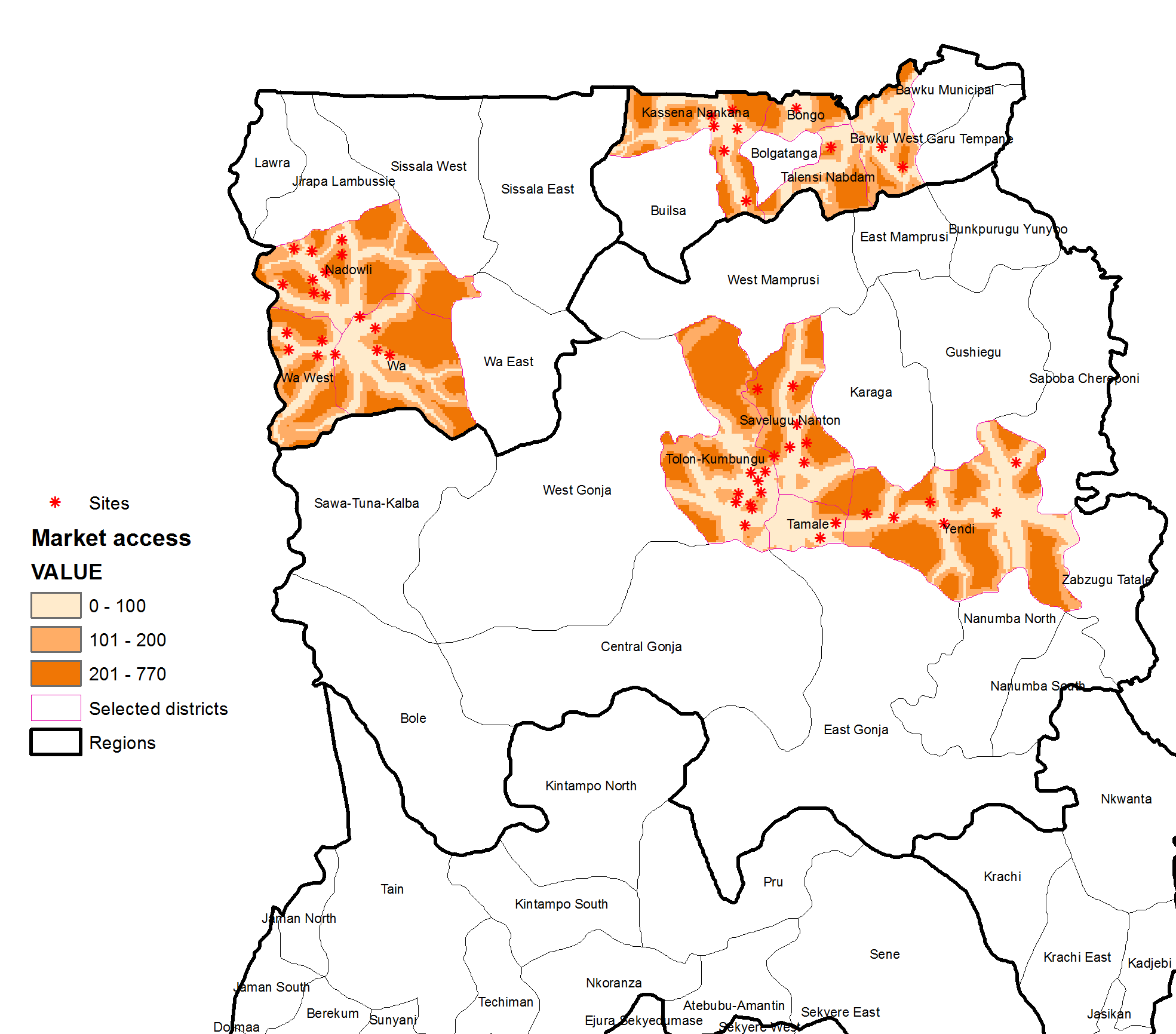


Figure 8. Market access

1. **Land cover**

There are various land cover datasets available at global scale. One of the commonly used is by GLC 2000. The map is shown in Figure 9.

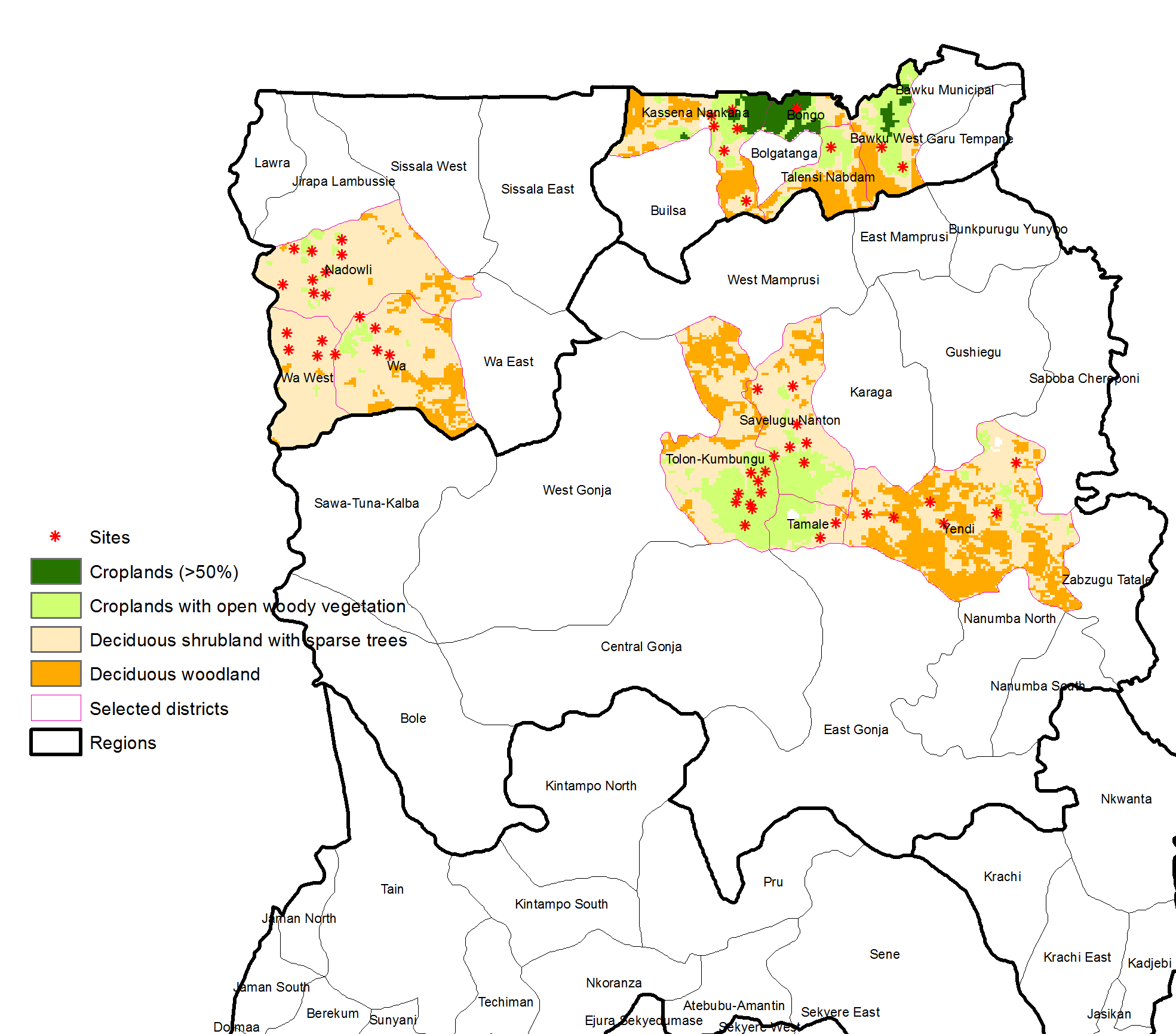


Figure 9. Land cover

**Proposed stratification for site selection**

After a review of the candidate variables, the variables of length of growth period by ICRISAT and market access are the final chosen variables used for the stratification process. The LGP is classified into 4 classes: low, med-low, med-high, high. The market access layer is classified into 3 classes: low, med, high. The cut-offs are shown in Table 3.

|  |  |  |
| --- | --- | --- |
| Class | Length of Grow period | Market access |
| Low | <= 162 | >= 200 |
| Med Low | 162 – 180 | 100 - 200 |
| Med high | 180 – 190 |  |
| High | >190 | <= 100 |

Table 3. Proposed variables and their cut-offs

The chosen variables are summarized at the district level, and average values are reported in Table 4.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Admin names | Length of growth period | Population density | Rainfall | Elevation | Market access |
| Nadowli | 166 | 1,350 | 990 | 283 | 187 |
| Bawku West | 158 | 85 | 961 | 205 | 123 |
| Kassena Nankana | 152 | 181 | 953 | 208 | 165 |
| Bongo | 154 | 173 | 917 | 224 | 148 |
| Talensi Nabdam | 161 | 142 | 994 | 194 | 148 |
| Wa | 178 | 1,350 | 1,039 | 298 | 201 |
| Wa West | 180 | 19 | 1,048 | 268 | 160 |
| Savelugu Nanton | 181 | 866 | 1,067 | 138 | 176 |
| Tolon-Kumbungu | 183 | 1,797 | 1,057 | 133 | 186 |
| Yendi | 194 | 1,195 | 1,176 | 170 | 181 |
| Tamale | 189 | 1,780 | 1,105 | 146 | 60 |

Table 4. Average values at the district level

Similarly, Table 5 reports average values of the same variables at the community level.



Table 5. Average values at the community level

In order to reduce the number of combinations, the final variables used are length of growth period and market access. The latter variable has been chosen as being a proxy of population density (relatively homogeneous in Northern Ghana, therefore not suitable for stratification purposes). LGP is classified into 4 classes (low, med-low, med-high, high), while market access is classified into 3 classes (low, med, high). LGP and market access classes are then matched to stratify the districts in Northern Ghana. Average values and combined classes of LGP and market access at the district level are listed in Table 6 and the associated map is displayed in Figure 10.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Admin name | LGP | LGP class | Market access | Market access class | Final class |
| Nadowli | 166 | Med-Low | 187 | Med | Med-Low LGP \* Med mkt |
| Bawku West | 158 | Low | 123 | Med | Low LGP \* Med mkt |
| Kassena Nankana | 152 | Low | 165 | Med | Low LGP \* Med mkt |
| Bongo | 154 | Low | 148 | Med | Low LGP \* Med mkt |
| Talensi Nabdam | 161 | Low | 148 | Med | Low LGP \* Med mkt |
| Wa | 178 | Med-High | 201 | Low | Med-High LGP \* Low mkt |
| Wa West | 180 | Med-High | 160 | Med | Med-High LGP \* Med mkt |
| Savelugu Nanton | 181 | Med-High | 176 | Med | Med-High LGP \* Med mkt |
| Tolon-Kumbungu | 183 | Med-High | 186 | Med | Med-High LGP \* Med mkt |
| Yendi | 194 | High | 181 | Med | High LGP \* Med mkt |
| Tamale | 189 | Med-High | 60 | High | Med-High LGP \* High mkt |

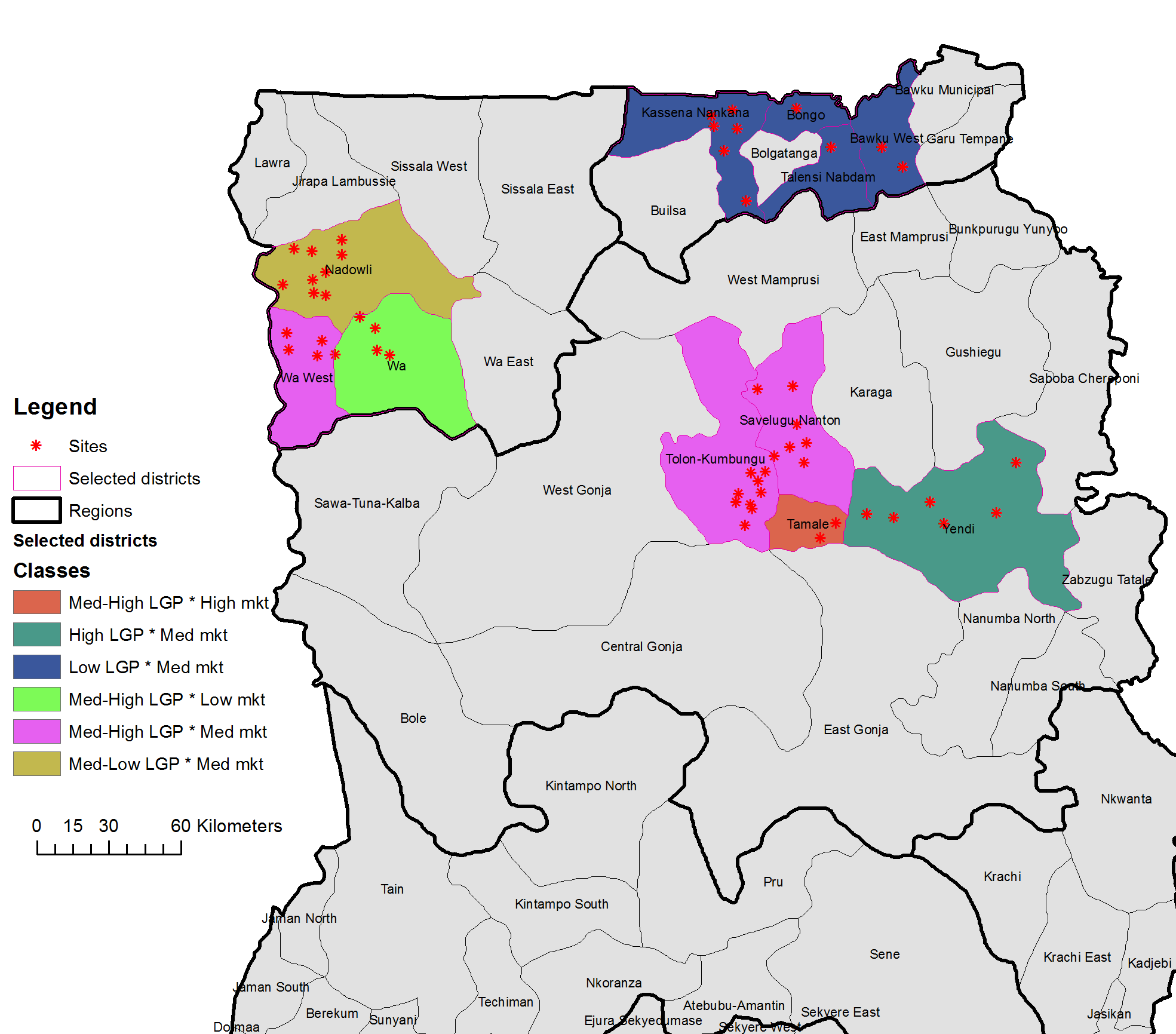
Table 6. LGP, market access, and their intersection at the district level

Figure 10. Combination of Length of growth period (4 classes) and Market access (3 classes)

**Conclusions**

The stratification process uses length of growth period (LGP) and market access as proxies of agriculture potential and socio-economic integration in the food value chain, respectively. Combining the two criteria, six unique classes are derived. It is suggested to choose the intervention communities in five classes/strata, perhaps avoiding the Tamale district (the only one with mid-high LGP and high market access), because its small size does not allow ruling out contamination of control sites given the inevitable proximity to action sites.

Given the close proximity between the 29 intervention and the 23 counterfactual communities/sites previously identified, and the new stratification proposed in this document, a re-selection of communities in the 11 districts is advised. The re-selection would need to guarantee an adequate coverage of the spectrum of biophysical and socio-economic conditions prevailing in the targeted districts, allowing for a broad assessment of the interventions in areas with different agricultural potential.

In particular, it is recommended to keep the identified 52 communities, but disregard the previous distinction between intervention and counterfactual communities. Action sites/communities should be chosen within the red circles, while control communities should be chosen within the white circles, shown in Figure 10. This way the control communities would be located within the same stratum identified, but with enough remoteness to reasonably avoid potential contamination between actions and counterfactual sites, although the final selection between intervention and control areas should be informed by local knowledge (e.g. to check if they share markets or other public facilities and verify their actual agricultural potential). Only after intervention communities will be chosen, control communities will be selected randomly within the identified control areas.